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EXAMPLE OF INTERACTION EFFECTS IN TRANSDUCER ARRAYS. PART II.(U)
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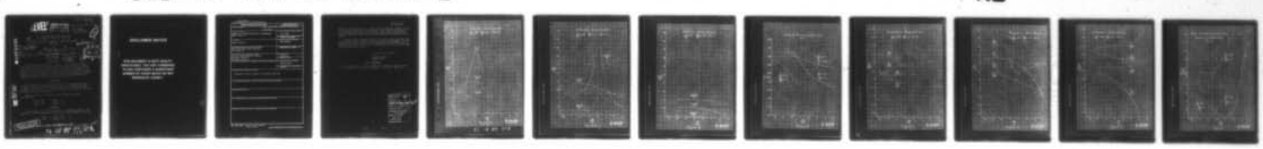

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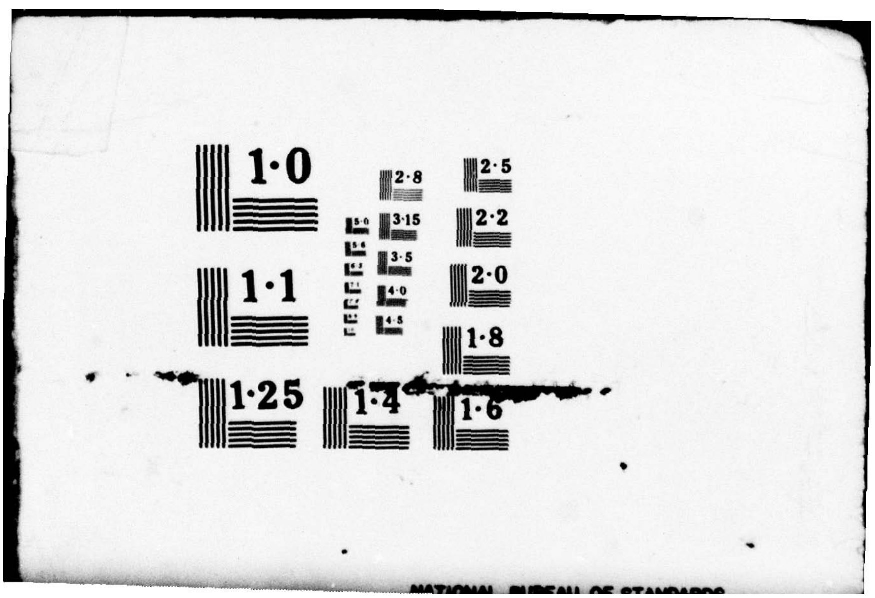
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EXAMPLE OF INTERACTION EFFECTS IN TRANSDUCER ARRAYS, PART II.

by

Judith F. Atwood

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USL Technical Memorandum No. 912-44-62 PT-2

25 May 1962

13p.

INTRODUCTION

The material presented here is an extension of the memorandum "Example of Interaction Effects in Transducer Arrays" by Sherman and Atwood (reference (a)). The array concerned consists of one circular piston surrounded by six other pistons in an infinite rigid baffle. The value of ka specified for each element is ka = .5. Calculations for piston velocities and radiation impedance are made for given spacings and individual transducer efficiency, while varying the internal mechanical reactance Xm. The power and the mechanoacoustical efficiency of the array are also shown as functions of Xm.

CALCULATIONS

The variable used in this case is the ratio of the internal mechanical reactance to the self radiation reactance, Xm/X_{11}. The resonant frequency of a single isolated transducer, at which the previous calculations were made, corresponds to an $Xm/X_{11} = -1$. All other conditions and notations are the same as those used by Sherman and Atwood.

Three combinations of spacing and single transducer efficiency are considered:

d/2a = 1.86	RM/R_{11} = .11
d/2a = 1.18	RM/R_{11} = .11
d/2a = 1.18	RM/R_{11} = 1.0

CONCLUSIONS

A small change in Xm might be considered to be caused by a change in the frequency. The relationship between Xm and the frequency change, $\Delta\omega = \omega - \omega_{11}$, is:

$$\frac{\Delta\omega}{\omega_{11}} \approx \frac{\eta X_{11}}{2 Q_{11} R_{11}}\left(\frac{X_M}{X_{11}} + 1\right)$$

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where Q_{11} is the mechanical Q of a single isolated transducer in water, and ω_{11} is the resonant frequency of that transducer. Thus, Figure 9 shows that, for the loose-packed case ($d/2a = 1.86$), a slight variation from the individual transducer resonance increases the array's mechanoacoustic efficiency significantly.

It may be pointed out again that, for the velocity limited situation, the use of highly efficient elements in such an array has disadvantages. The power radiated by the array (Figure 8) is considerably lower, and the efficiency of the whole array (Figure 9) is subject to much sharper variations when the single transducer efficiency is high.

Judith F. Atwood

JUDITH F. ATWOOD
Mathematician

LIST OF REFERENCES

(a) C. H. Sherman and J. F. Atwood, "Example of Interaction Effects in Transducer Arrays", USL Technical Memorandum No. 912-20-62, 1 March 1962

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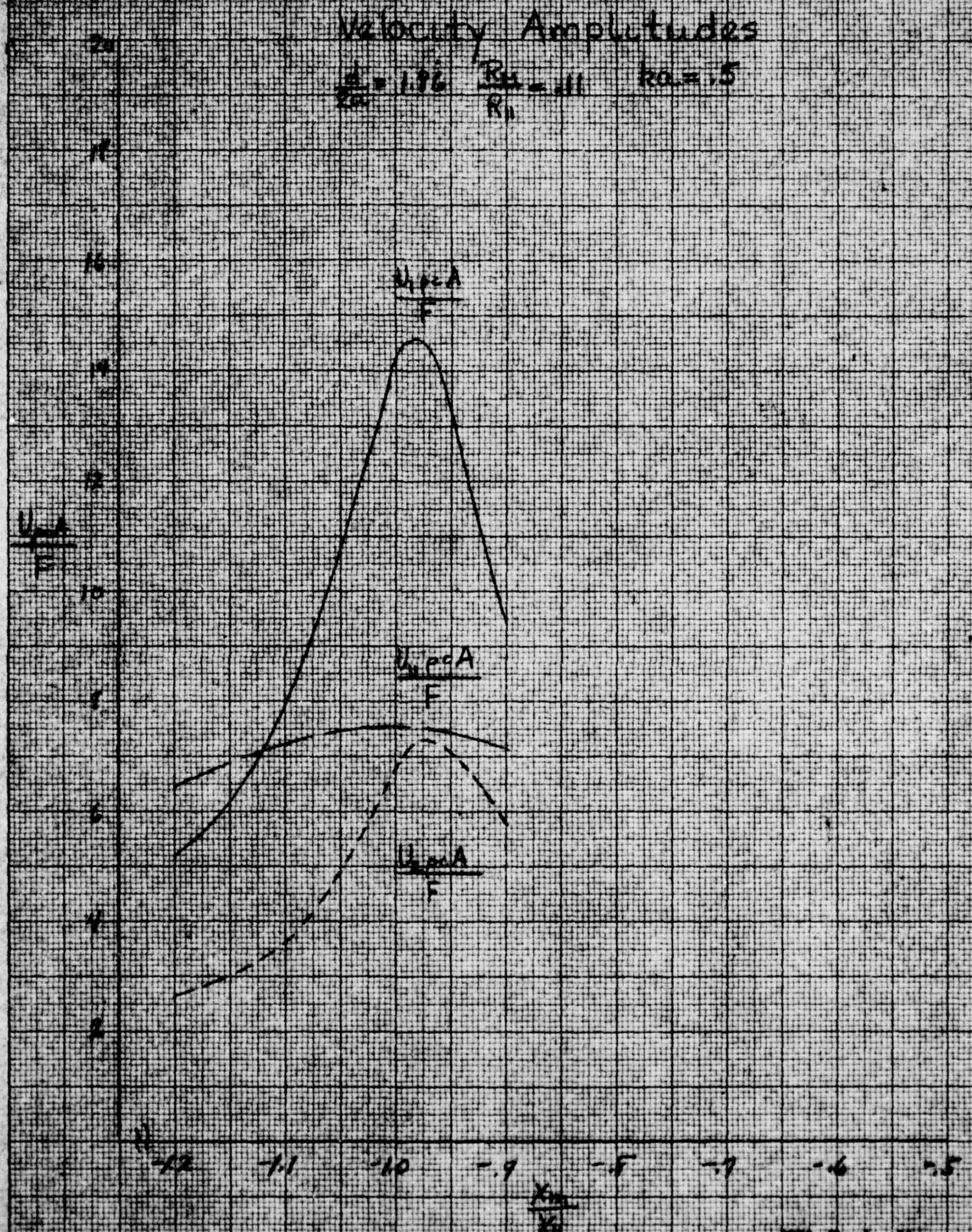

Figure 1

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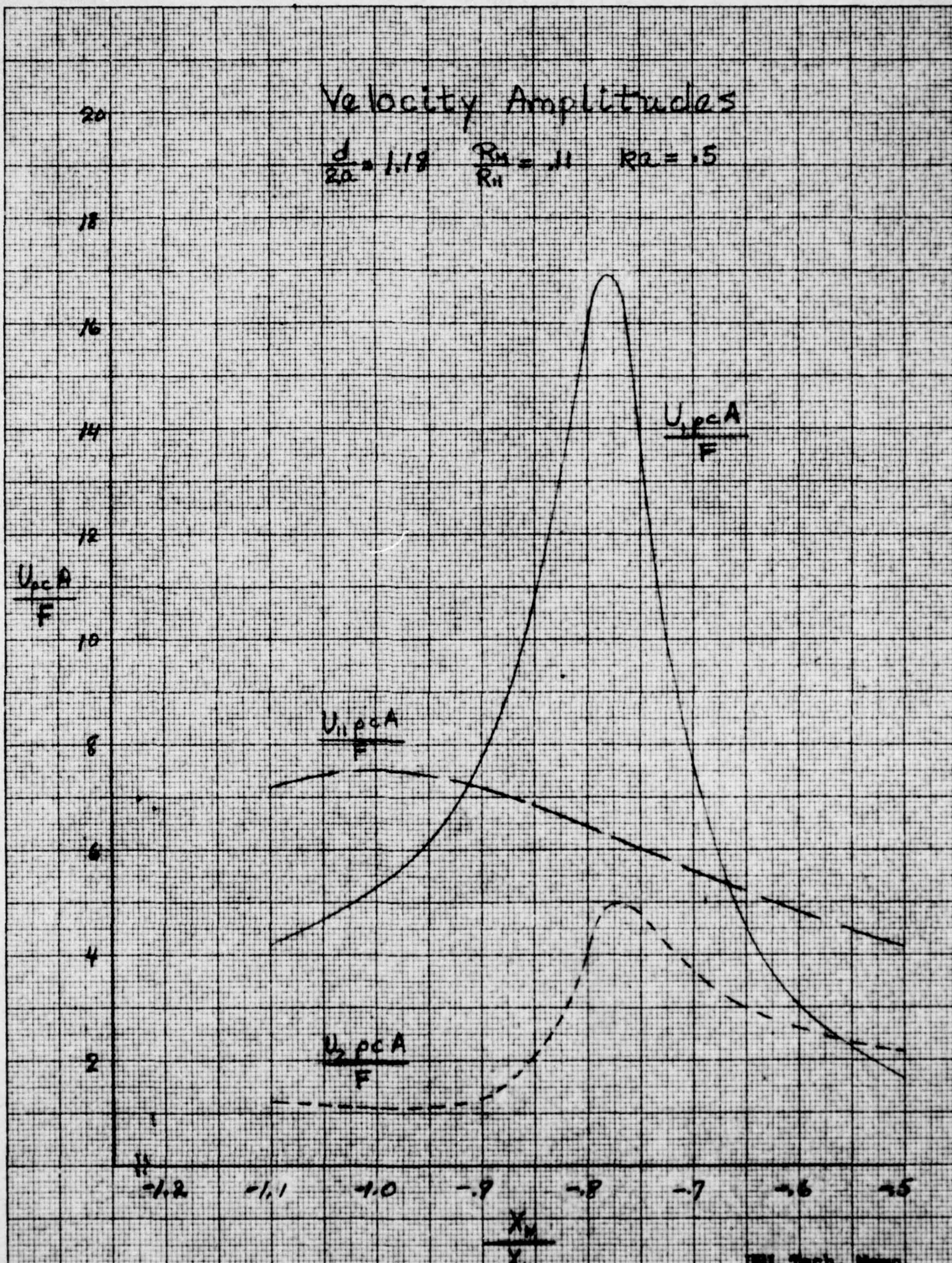

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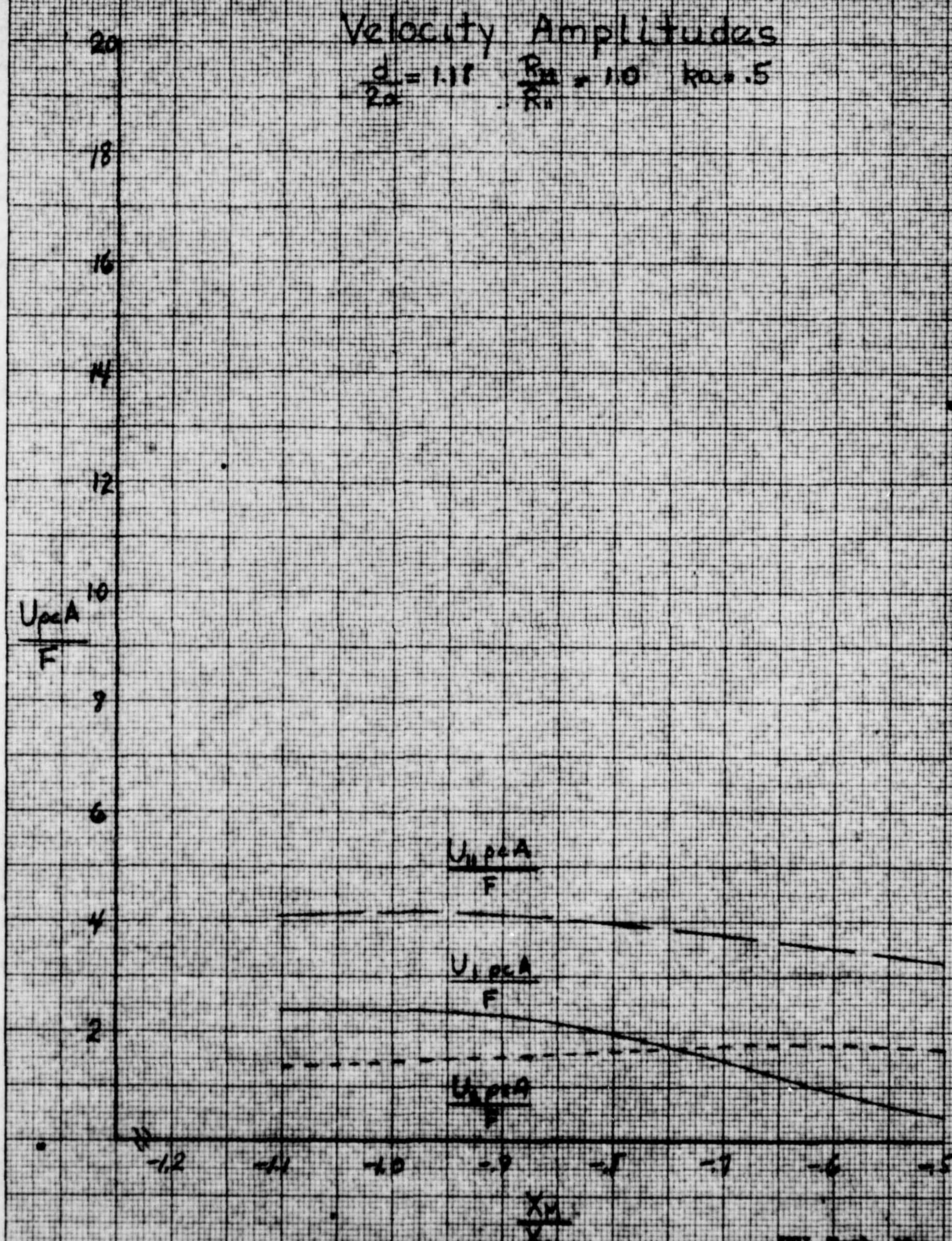

Figure 3.

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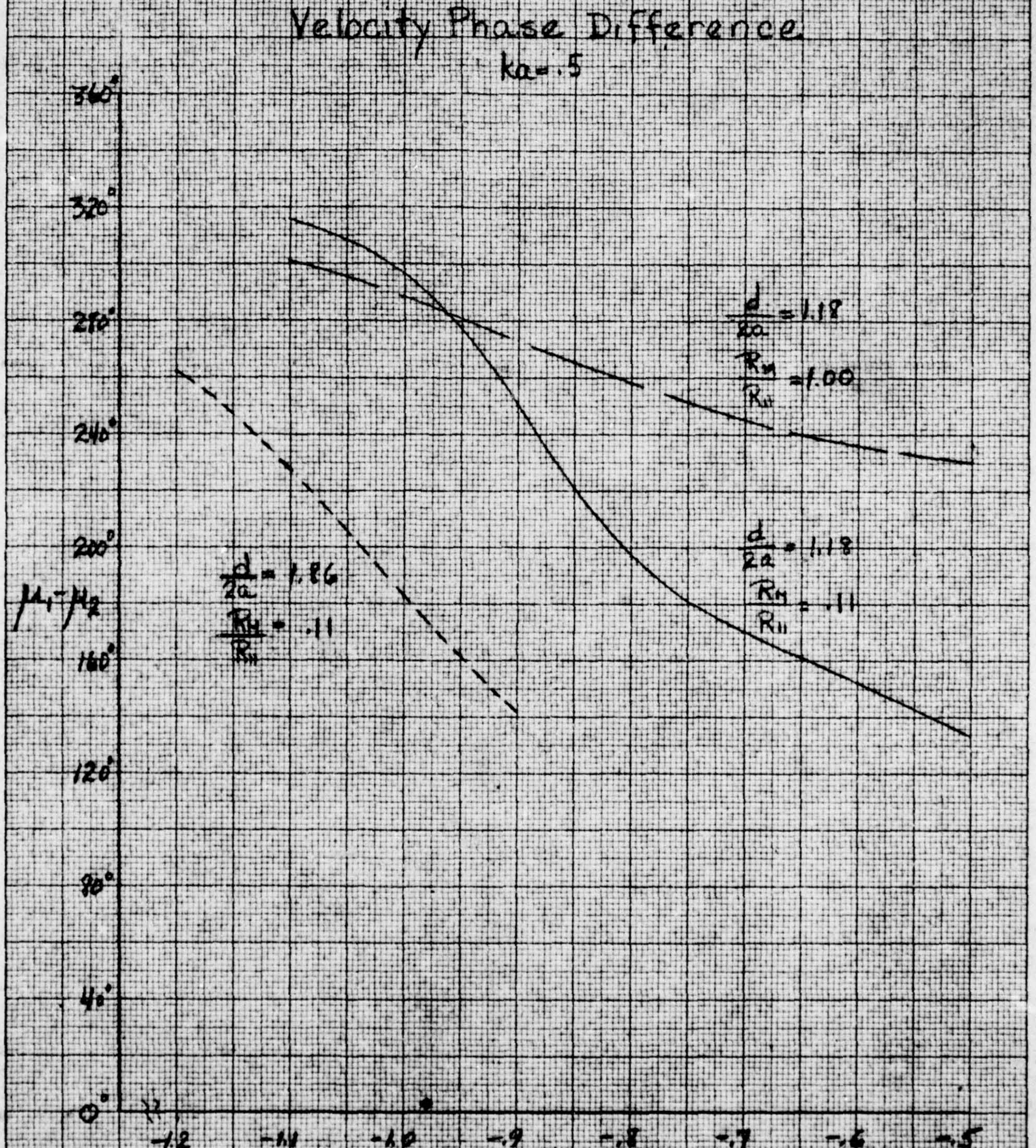

Figure 4.

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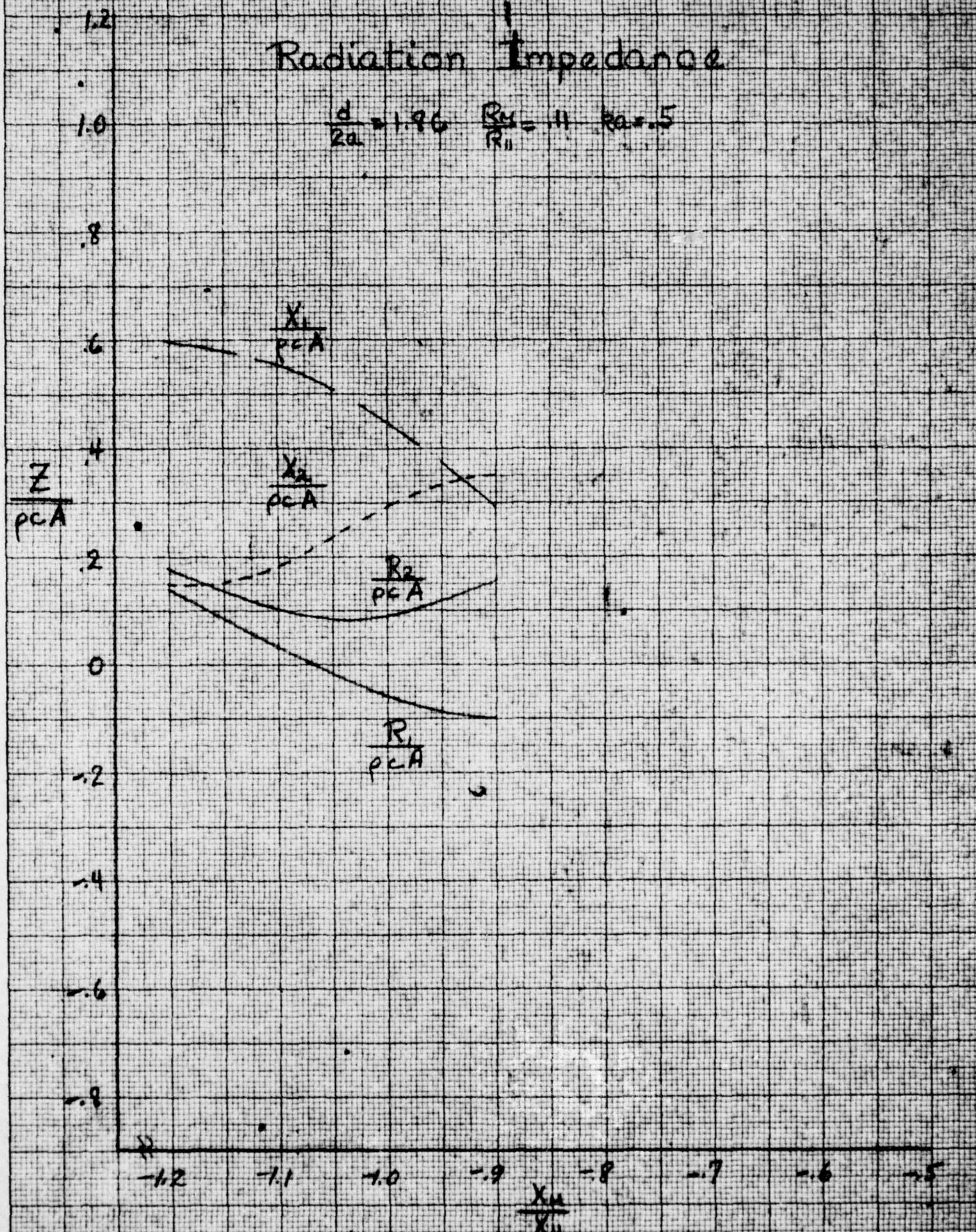

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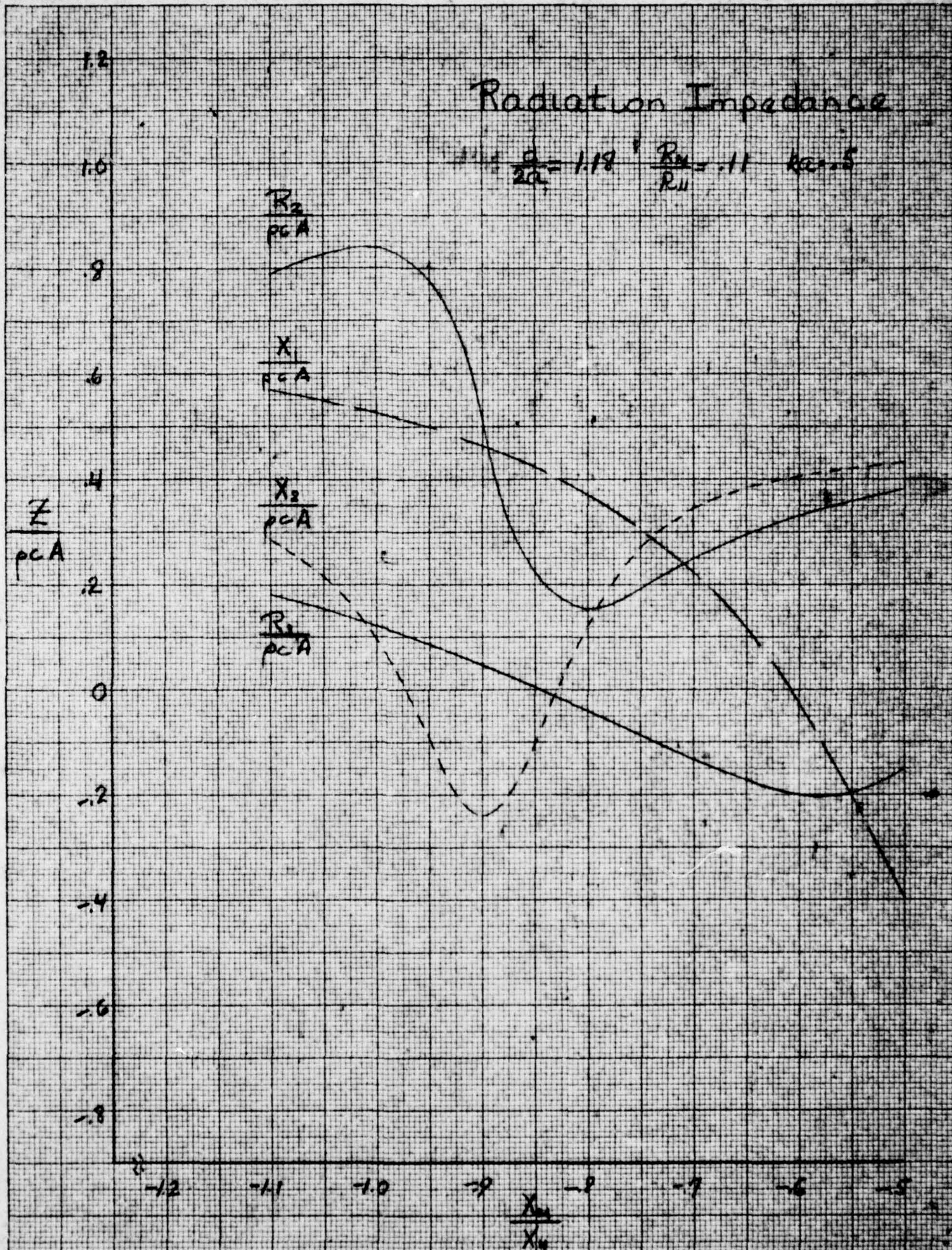

Figure 6

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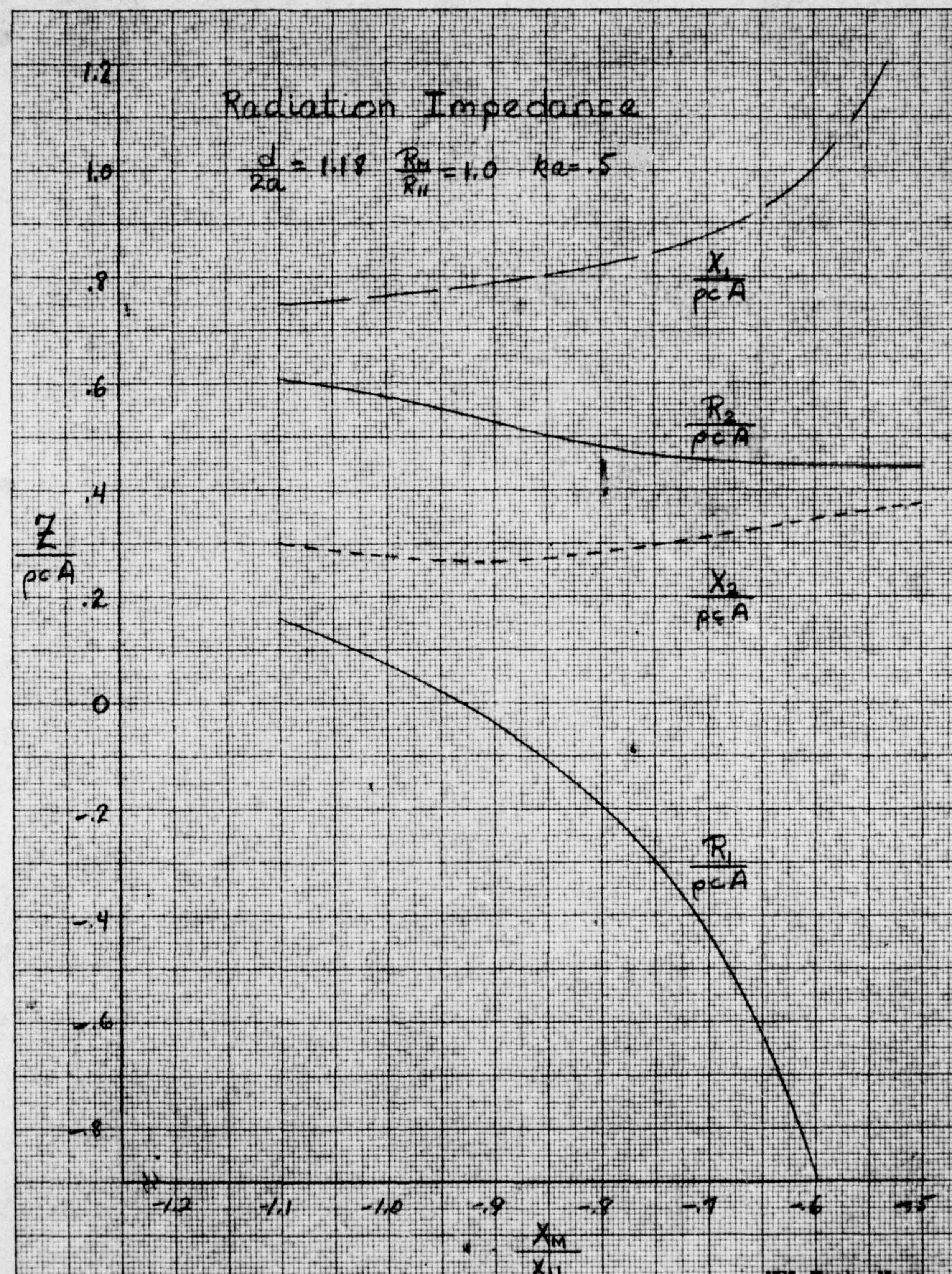

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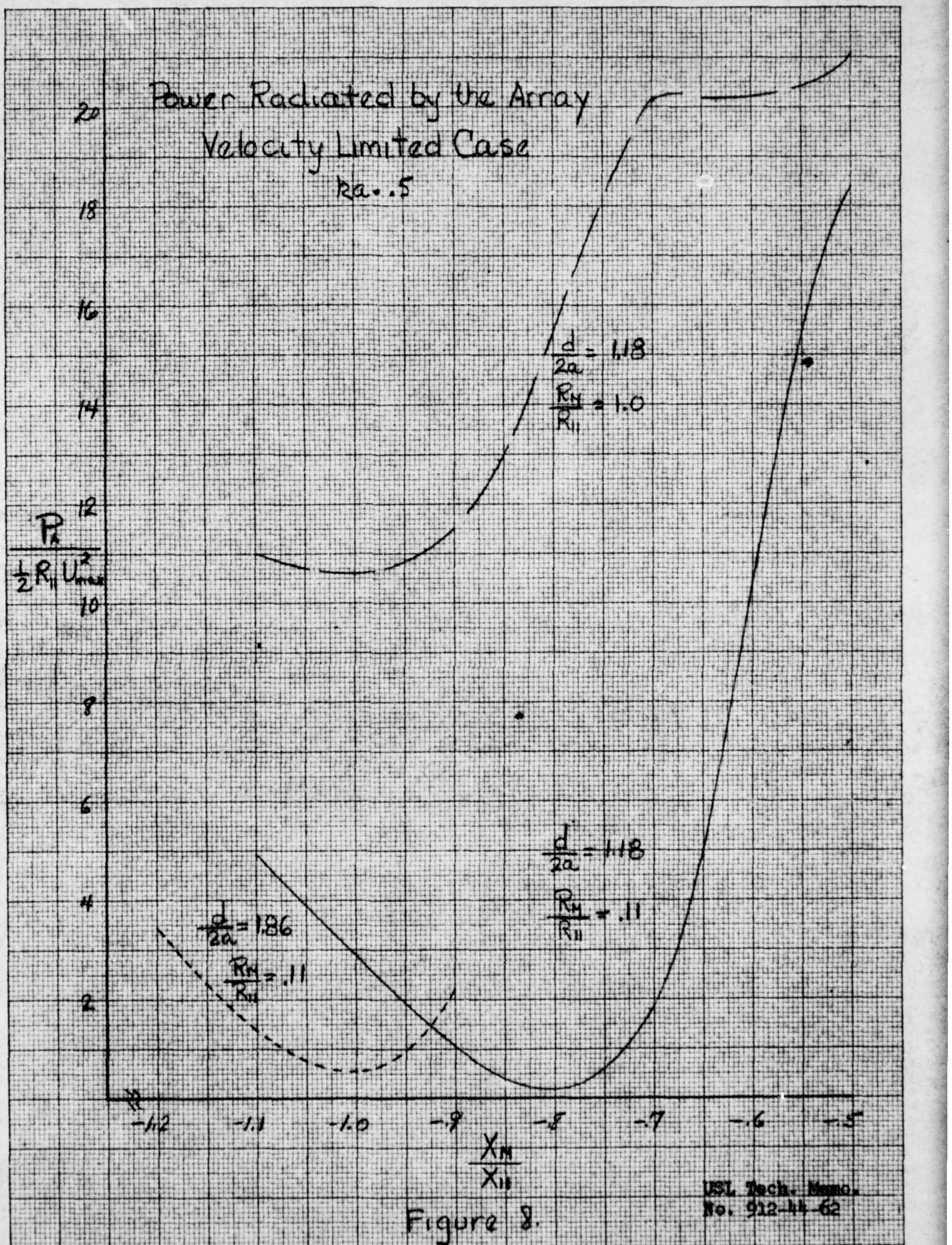

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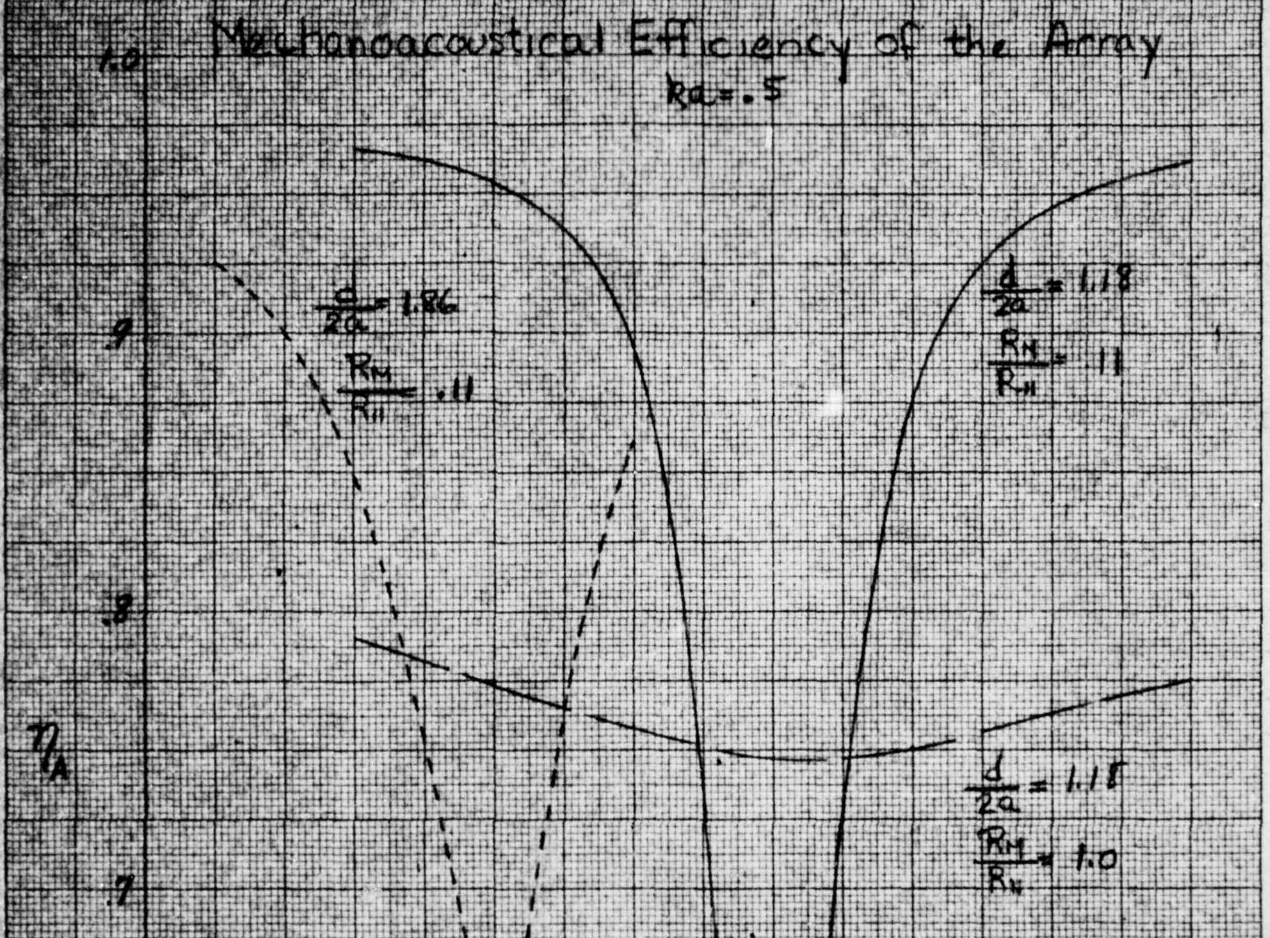

Figure 9

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